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## **Violations of Procedure Invariance in Preference Measurement: Cognitive Explanations**

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A violation of procedure invariance in preference measurement is that the predominant or prominent attribute looms larger in choice than in a matching task. In Experiment 1, this so-called prominence effect was demonstrated for choices between pairs of options, choices to accept single options, and preference ratings of single options. That is, in all these response modes the prominent attribute loomed larger than in matching. The results were replicated in Experiment 2, in which subjects chose between or rated their preference for pairs of options which were matched to be equally attractive either in the same session or 1 week earlier. On the basis of these and previous results, it is argued that the prominence effect is a reliable phenomenon. However, none of several cognitive explanations which have been offered appears to be completely viable.

### **INTRODUCTION**

Previous research in decision making indicates that normatively equivalent procedures of preference measurements do not result in the same preference order. For instance, judgements and choices are not always in perfect

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agreement (e.g. Slovic, Griffin, & Tversky, 1990; Slovic & Lichtenstein, 1983; Tversky, Sattah, & Slovic, 1988; see Payne, Bettman, & Johnson, 1992b, for a review). Such violations of procedure invariance may be traced to differences in decision makers' cognitive processing of information. In this vein, it has been found that multi-attribute options are processed more completely when subjects make judgements than when they make choices (Billings & Scherer, 1988; Lindberg, Gärling, & Montgomery, 1989; Westenberg & Koele, 1990; 1992).

Recently, Slovic et al. (1990) and Tversky et al. (1988) demonstrated a judgement-choice discrepancy which they termed the "prominence" effect. This effect has been obtained in the simplest possible case when subjects are presented with two options described by two attributes, for instance two alternative medical treatments which differ in effectiveness and pain relief. One of the attributes (e.g. effectiveness) is selected to be predominant or prominent. A prominence effect is observed when subjects, in choosing one of the options, place more weight on the prominent attribute (i.e. effectiveness) than they do in a matching task. In the matching task, subjects are similarly presented with both options, but one attribute value is missing for one of the options. The subjects' task is to supply a value which makes the two options equally attractive.

Subsequently, the prominence effect has been replicated by Montgomery, Gärling, Lindberg and Selart (1990) and Montgomery, Selart, Gärling and Lindberg (1994). Two alternative cognitive explanations have been offered. One is the compatibility hypothesis first proposed by Tversky et al. (1988). An alternative explanation, the restructuring hypothesis, was suggested by Montgomery et al. (1990; 1994). Both hypotheses are reviewed briefly below.

### The Compatibility Hypothesis

According to Slovic et al. (1990) and Tversky et al. (1988), the prominent effect reflects a general principle of compatibility according to which the processing of input (e.g. attributes describing options in a judgement or choice task) depends on how compatible it is with the output (i.e. subjects' responses). Identical components on both the stimulus and the response side enhance compatibility. Such components include the use of the same scale units (e.g. grades, ranks), the direction of relations (e.g. whether the correlation between input and output variables is positive or negative), and the numerical correspondence (e.g. similarity between the input and output variables). Another form of compatibility is that the qualitative response in choice is more compatible with a choice rule (such as the lexicographic rule; see Svenson, 1979), which renders quantitative weight-



ing of attributes unnecessary. In contrast, quantitative judgements are compatible with quantitative weighting.

In order to account for their results, Montgomery et al. (1994) suggested a modification of the compatibility hypothesis. Instead of compatibility between choice rule and response, they assumed that the required output from subjects needs to be compatible with the *structure of information* in input. Whereas choices are different from both quantitative matching and preference ratings, the latter are different from the former in calling for ratings of single options rather than judging one difference relative to another. Thus, one may expect a prominence effect also for preference ratings, although it is not possible to predict how strong it will be relative to that for choice.

Slovic et al. (1990) suggest two psychological rationales for the compatibility hypothesis. One is that non-compatibility requires additional mental operations which subjects avoid. A second rationale is that a response mode primes or focuses attention on the compatible features of the input.

### The Restructuring Hypothesis

The restructuring explanation of the prominence effect is based on the dominance-structuring theory of decision making proposed by Montgomery (1983; 1989). In this theory, it is assumed that subjects making choices restructure the available information to make one option dominate the other(s). Subjects may therefore increase differences between options on important attributes and decrease differences on unimportant attributes. Similar assumptions have been made more recently by Svenson (1992). If there is one prominent and one non-prominent attribute, as a result of the restructuring process, the former will have more influence, since the difference on that attribute is enlarged relative to the latter.

The restructuring hypothesis has been investigated using two methods: (1) attractiveness ratings of attribute levels in connection with the choices being made (Montgomery et al., 1990), and (2) think-aloud reports (Montgomery et al., 1994). An indication of restructuring is that the differences between rated attractiveness of attribute levels change. From think-aloud protocols, the frequency of evaluative statements is compiled (Montgomery & Svenson, 1989). Restructuring is then similarly inferred from changes in these frequencies. As noted by Montgomery et al. (1994), the latter may be a more sensitive measure.

Collecting think-aloud reports is essential for distinguishing the restructuring explanation from the compatibility hypothesis. According to the former hypothesis, changes in relative frequencies of evaluations of attri-



bute levels are expected. In contrast, the compatibility hypothesis predicts differences in attention to attribute weights.

### Problems and Experimental Hypotheses

Montgomery et al. (1990; 1994) investigated the relative merits of the compatibility and restructuring hypotheses. In line with the standard procedure (Tversky et al., 1988) used to demonstrate the prominence effect, subjects chose between two options, which through a prior matching task had been made equally attractive. In addition, other groups of subjects rated their preference for each option. The results of both studies showed restructuring in connection with choices. Consistent with the restructuring hypothesis, Montgomery et al. (1990) demonstrated a prominence effect for choices. However, although no restructuring was observed, like Fischer and Hawkins (1993) in a more recent study, Montgomery et al. (1994) found an equally strong prominence effect for preference ratings. A crucial factor accounting for the latter appeared to be whether options were presented simultaneously rather than sequentially (Birnbaum, 1992; Lindberg et al., 1989). Furthermore, the prominence effect also appeared to be reduced if subjects were asked to rate the attractiveness of the options' attribute levels on the same trials as they performed preference ratings. By focusing their attention on the non-prominent attribute, both factors may induce subjects to use a compensatory decision rule. Since the strength of the prominence effect for choices was not affected by simultaneous ratings of attribute levels, the cause of the effect may be different from that for preference ratings.

If restructuring explains the prominence effect, a factor which increases restructuring should be expected to increase the prominence effect as well. Furthermore, increased restructuring accompanied by an increased prominence effect is expected for choices but not for sequentially presented preference ratings. Montgomery (1983; 1989) and Svenson (1992) both assume that the importance of a decision is a motive for restructuring. A decision may be more important if the consequences have personal relevance. In Experiment 1, two different sets of pairs of choice options were constructed. One set consisted of options which were framed as personally relevant, the other set consisted of options which were not directly personally relevant. The higher degree of personal relevance was expected to increase restructuring, and therefore an increased prominence effect is predicted from the restructuring hypothesis. In contrast, no difference is predicted from the compatibility hypothesis. Different groups of subjects who either made choices or performed preference ratings were given the different sets of choice options. Think-aloud protocols were obtained as a means of assessing the degree of restructuring.

Personal relevance or involvement was found by Borgida and Howard-Pitney (1983) to increase the saliency of less important information. This finding suggests that subjects may give more attention to the non-prominent attribute when presented with personally relevant choice problems. Even though compatibility does not change, this may result in a *weaker* prominence effect. Such an outcome would give credibility to one of the rationales behind the compatibility hypothesis, namely that the non-prominent attribute is less attended. However, in contrast to the predictions from both the restructuring and compatibility hypotheses, if personal relevance increases attention to the non-prominent attribute, a reduced prominence effect would be expected for both preference ratings and choices.

That options are presented simultaneously rather than sequentially was found to increase the prominence effect for preference ratings (Montgomery et al., 1990; 1994). In these experiments, options were always presented simultaneously when subjects made choices. Consistent with findings obtained by Payne, Bettman, Coupey and Johnson (1992a), sequential presentation is likely to reduce restructuring. The question was therefore raised whether a weaker prominence effect would also be obtained for choices if options were presented sequentially. Under different conditions in Experiment 1, subjects were asked to make choices of pairs of options which were presented simultaneously or singly, just as they were in the preference-ratings conditions of Montgomery et al. (1990; 1994).

In previous experiments (Montgomery et al., 1990; 1994), the prominence effect was assessed by comparing choices or preference ratings obtained from one group of subjects with another group who performed the matching task. In Experiment 2, the question was raised whether a prominence effect would also be obtained if the same subjects performed the matching task, either on the same or on a different occasion as they performed the choice or preference-rating task. If both tasks are performed on the same occasion, this may counteract restructuring and decrease the prominence effect for choices. It may also decrease the prominence effect for preference ratings when they entail choices, as they are assumed to do when options are presented simultaneously. Furthermore, since performance of the matching task on the same or a different occasion does not affect compatibility, no difference in prominence effect was expected on the basis of the compatibility hypothesis.

Table 1 summarises predictions of the prominence effect from both versions of the compatibility hypothesis and from the restructuring hypothesis. Only the revised compatibility hypothesis and the restructuring hypothesis predict a prominence effect for both choices and preference ratings under what is called a standard condition (simultaneous presenta-



TABLE 1  
Predictions of the Prominence Effect from Different Hypotheses

	<i>Compatibility Hypothesis</i>					
	<i>Decision Rule vs Response</i>		<i>Information Structure vs Response</i>		<i>Restructuring Hypothesis</i>	
	<i>Choice</i>	<i>Preference Rating</i>	<i>Choice</i>	<i>Preference Rating</i>	<i>Choice</i>	<i>Preference Rating</i>
<i>Standard condition:</i>						
Simultaneous presentation of options, personally less relevant problems, non-simultaneous matching	Yes	No	Yes	Yes	Yes	Yes
<i>Experimental conditions:<sup>a</sup></i>						
Personally relevant problems	0 <sup>b</sup>	No	0	0	+	+
Sequential presentation of options <sup>c</sup>	0	No	—	—	0	—
Personally relevant problems, sequential presentation of options	0	No	—	—	+	—
Simultaneous aspect ratings/matchings	0	No	—	—	—	—
Simultaneous aspect ratings/matchings, sequential presentation of options	0	No	—	—	—	—

<sup>a</sup>The experimental conditions are in other respects the same as the standard condition.

<sup>b</sup>0 denotes no change, + an increase and — a decrease in the prominence effect compared with the standard condition.

<sup>c</sup>Choices in this condition are assumed to correspond to choices to accept.



tion of options, personally less relevant decisions, and non-simultaneous matching or attribute ratings). The prediction is confirmed by previous results (Montgomery et al., 1990; 1994). However, it should be noted that the prediction from the restructuring hypothesis is based on the assumption that preference ratings entail choices when options are presented simultaneously. Against this is the view that the evidence for restructuring in connection with preference ratings is unequivocal (Montgomery et al., 1990; 1994). Thus, the revised compatibility hypothesis is more plausible, since it explains the prominence effect for preference ratings without assuming restructuring.

Under the present experimental conditions (changes of the standard condition), the original compatibility hypothesis never predicts a prominence effect for preference ratings. Furthermore, for choices it does not predict any change in the strength of the effect. In contrast to the restructuring hypothesis, neither of the compatibility hypotheses predicts a stronger prominence effect for personally relevant choice problems. Another difference between the revised compatibility and restructuring hypotheses is that the latter does not predict a weaker prominence effect for choices of options presented sequentially.

## EXPERIMENT 1

### Method

*Subjects.* Seventy-two undergraduate students of psychology at Göteborg University served as subjects in return for payment. Twelve subjects were randomly assigned to each condition.

*Materials.* The materials consisted of eight choice problems, each of which comprised two alternative medical treatments. There were two possible attributes or outcomes, one of which was assumed to be more important or prominent than the other. The outcomes could range from 1, defined as an extremely small degree of the attribute, to 100, defined as an extremely large degree of the attribute. Attribute levels were selected on the basis of the results of a pilot study. In this study, 24 individually serving subjects recruited from the same population as in the main study were presented with the eight choice problems. As in the main study, half of the subjects were given problems which were assumed to be personally relevant; the other half of the subjects were given problems which were assumed to be personally less relevant. The difference was created through the descriptions (as described below), whereas the attributes remained the same. The subjects' task was first to fill in a missing value so that the

options appeared equally attractive, then to indicate which attribute they considered to be the most important.<sup>1</sup> The missing values were chosen as the least attractive levels of the non-prominent attributes, which was expected to result in the largest prominence effect for choices (Tversky et al., 1988). In constructing the choice problems, pooled mean values<sup>2</sup> from the two conditions of the pilot study were used to create options which were equally attractive. Table 2 displays the prominent and non-prominent attributes and their levels entailed by the different choice problems. Across the different problems, the order between the prominent and non-prominent attributes was counterbalanced. When both options were presented simultaneously, whether the option with the highest value for the prominent attribute (termed prominent option) was presented above or below was also counterbalanced across problems.

**Procedure.** The subjects participated individually in sessions lasting for about 40 min. One-third of the subjects made choices of options presented pairwise on separate pages in a booklet. Another third accepted or rejected options which were presented singly. The final third of the subjects performed preference judgements of singly presented options. In each condition, the order was individually randomised. In the conditions with sequential presentation, pairs of options comprising the choice problems in the simultaneous presentations were maximally separated.

In the choice conditions, subjects indicated with a cross which one in the pairs of options they preferred. The typewritten descriptions of personally relevant choice problems read as follows (exemplified with #1): "Suppose you need medical treatment for a serious disease. There exist two different treatment programmes. One is more effective but gives less pain relief. The other is less effective but gives more pain relief. The figures below indicate on a scale ranging from 1 (extremely small) to 100 (extremely

<sup>1</sup>The same information is obtained from the matched value as follows. If  $u$  denotes the attractiveness of the attribute levels, matching is supposed to correspond to the equality  $u_{P,P} - u_{P,N} = u_{NP,NP} - u_{NP,NP}$  (where the first index refers to the prominent/non-prominent option defined as the option with the highest/lowest value for the prominent attribute, and the second to the prominent/non-prominent attribute). Assume further that  $u$  is related to the attribute levels  $x$  through  $u = a + bx$  (where  $b$  is an attribute weight assigned to the prominent and non-prominent attributes, respectively), so that  $b_P/b_{NP} = (x_{NP,NP} - x_{P,NP}) / (x_{P,P} - x_{NP,P})$ . Thus, the smaller the difference between attribute levels, the higher the weight (prominence) for that attribute. Conversely, from the ratio of the differences, the weight ratio can be calculated.

<sup>2</sup>On average, the ratio between the weights for the prominent and non-prominent attributes was 1.60 in the condition with personally relevant choice problems and 1.17 in the other condition. Despite the mean difference in ratios,  $t$ -tests indicated that none of the differences between the conditions were reliable ( $P = 0.05$ ) for the different problems.



TABLE 2  
Attribute Levels<sup>a</sup> for Choice Problems (Medical Treatments) Presented to Subjects

	<i>Attribute</i>	<i>Option 1</i>	<i>Option 2</i>
1.	<i>Medical care<sup>b</sup></i> Freedom from disturbance	65 47	54 62
2.	<i>Health improvement</i> Comfort	61 48	52 64
3.	<i>Efficiency</i> Pain relief	56 46	47 58
4.	<i>Medical skill</i> Freedom from fees	59 35	42 55
5.	<i>Food value</i> Size of food portions	66 49	51 63
6.	<i>Protection against relapse</i> Programme shortage	55 35	40 52
7.	<i>Medical follow-up</i> Freedom from encroachment	56 28	43 59
8.	<i>Communication with staff</i> Leisure	66 46	51 63

<sup>a</sup>Attribute levels are expressed on a scale from 1 to 100.

<sup>b</sup>Prominent attribute in italics.

large) the extent to which the treatments are effective and pain-relieving, respectively. If you had a choice, which treatment would you choose?" For the other set of choice problems, the descriptions read as follows (the bits omitted were the same as above): "The community which is responsible for medical care has a choice between different treatments. In this case there exist two different treatments . . . Which treatment do you think should be chosen?"

The descriptions were essentially the same in the other conditions. In the choice-to-accept condition, subjects indicated with a cross for each option whether it was acceptable or not. In the remaining conditions, preference ratings were made of each option on a scale ranging from 1 (extremely bad) to 100 (extremely good).

All subjects were instructed to report orally their thoughts while making preference ratings or choices. If silent for more than approximately 10 sec,



the subjects were prompted to continue to report their thoughts. The verbal protocols were tape-recorded and later transcribed.

## Results

*Preference Ratings, Choices Between Options, and Choices to Accept.* Preference ratings, choices between options, and choices to accept were scored in an equivalent fashion. A score of 1 was assigned if the prominent option in each pair was chosen, accepted or given the highest preference rating. If both options received the same preference rating, or were both accepted or rejected, a score of 0.5 was assigned. In Table 3 the mean response scores are given for each response mode and problem type.<sup>3</sup> As indicated by the fact that the mean response scores were reliably larger than 0.50 for all response modes and problem types ( $P < 0.001$ ), a prominence effect was uniformly obtained. Some differences in strength of the prominence effect are evident in the table. A response mode (3)  $\times$  problem type (2) analysis of variance (ANOVA) indicated that the interaction between response mode and problem type was significant [ $F(2,66) = 3.78, P < 0.05$ ]. For choices between options, Tukey *post-hoc* tests showed that the prominence effect was reliably smaller for personally relevant problems and reliably larger for choices to accept. For preference ratings, there was no significant differences. For the personally relevant problems, the prominence effect was furthermore reliably smaller for choices between options than for the other response modes. For the personally less relevant problems, the prominence effect was reliably larger for choices between options than for the other response modes.

*Think-aloud Reports.* The processing of the think-aloud reports followed the procedure developed in previous research (e.g. Montgomery et al., 1994; Montgomery & Svenson, 1989; Svenson, 1989). First, the transcribed protocols were partitioned into statements corresponding to a main sentence or a string of words that could be rewritten as a sentence. Second, each statement was coded with respect to (1) which of the options, if any, it referred to, (2) which of the attributes, if any, it referred to, and (3) whether it was a positive evaluation, a negative evaluation or a neutral statement. Statements referring to the required ratings, choices between options, or choices to accept were not coded. The coded statements could apply to attributes, options without any attribute specified, or attribute levels for a specified option. A statement in which the subject compared

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<sup>3</sup>Analyses performed separately for each problem confirmed the results obtained at the aggregated level.

TABLE 3  
Mean Response Scores for Choice and Preference Rating (Experiment 1)

	Response Mode		
	Choice	Choice to Accept	Preference Rating
Personally relevant	0.78	0.87	0.85
Personally less relevant	0.90	0.78	0.81

the attractiveness of both options was coded as a positive evaluation of the preferred, and a negative evaluation of the non-preferred, option. Coding was made by one judge. The reliability was determined to be satisfactory, as indicated by 85% agreement for a randomly chosen 10% of all statements coded by an additional judge.

Statements which did not refer to options or attribute levels are given in Table 4. As revealed by a response mode (3)  $\times$  problem type (2)  $\times$  attribute (2) ANOVA with repeated measures on the last factor, no significant effect was found on the mean number of statements (attention index). In a parallel ANOVA on the mean difference between the number of positive and negative sentences (evaluation index), the prominent attribute received a significantly higher value than the non-prominent attribute [ $F(1,66) = 129.17, P < 0.001$ ].

Previous studies of restructuring of choice problems (Dahlstrand & Montgomery, 1984; Montgomery & Svenson, 1989) have shown that the

TABLE 4  
Means of Indices of Attention to and Evaluation of Attributes (Experiment 1)

	Attention Index		Evaluation Index	
	Prominent Attribute	Non-prominent Attribute	Prominent Attribute	Non-prominent Attribute
<i>Choice</i>				
Personally relevant	13.08	12.58	9.25	-1.25
Personally less relevant	15.25	15.80	9.25	-6.67
<i>Choice to accept</i>				
Personally relevant	15.33	14.33	13.33	-8.17
Personally less relevant	16.50	16.42	10.83	-2.92
<i>Preference rating</i>				
Personally relevant	16.17	18.83	14.83	-5.50
Personally less relevant	18.00	18.50	16.67	-7.50

TABLE 5  
Means of Indices of Attention to and Evaluation of Attribute Levels (Experiment 1)

	<i>Preferred Option</i>		<i>Non-preferred Option</i>	
	<i>Prominent Option</i>	<i>Non-prominent Option</i>	<i>Prominent Option</i>	<i>Non-prominent Option</i>
<b>Attention index</b>				
<i>Choice</i>				
<i>Personally relevant</i>				
Prominent attribute	2.42	0.50	0.08	1.25
Non-prominent attribute	1.67	0.67	0.25	0.92
<i>Personally less relevant</i>				
Prominent attribute	2.42	0.17	0.08	1.58
Non-prominent attribute	1.42	0.17	0.08	0.75
<i>Choice to accept</i>				
<i>Personally relevant</i>				
Prominent attribute	1.67	0.08	0.42	2.58
Non-prominent attribute	1.25	0.33	0.50	1.42
<i>Personally less relevant</i>				
Prominent attribute	2.50	0.58	1.33	3.00
Non-prominent attribute	1.17	0.42	1.17	2.17
<i>Preference rating</i>				
<i>Personally relevant</i>				
Prominent attribute	3.42	1.00	0.75	5.33
Non-prominent attribute	2.33	0.25	0.83	3.25
<i>Personally less relevant</i>				
Prominent attribute	2.17	0.42	1.00	2.25
Non-prominent attribute	2.33	0.50	0.58	1.83
<b>Evaluation index</b>				
<i>Choice</i>				
<i>Personally relevant</i>				
Prominent attribute	2.08	-0.33	0.08	-1.08
Non-prominent attribute	-0.83	0.67	-0.25	0.25
<i>Personally less relevant</i>				
Prominent attribute	2.33	-0.08	-0.08	-1.42
Non-prominent attribute	-1.25	0.17	-0.08	0.75
<i>Choice to accept</i>				
<i>Personally relevant</i>				
Prominent attribute	1.50	0.08	-0.08	1.42
Non-prominent attribute	-0.92	0.17	0.50	-1.42



TABLE 5 (Continued)

	Preferred Option		Non-preferred Option	
	Prominent Option	Non-prominent Option	Prominent Option	Non-prominent Option
<i>Personally less relevant</i>				
Prominent attribute	2.33	0.42	0.33	2.33
Non-prominent attribute	-1.17	0.25	0.83	-1.50
<i>Preference rating</i>				
<i>Personally relevant</i>				
Prominent attribute	3.08	0.33	-0.08	4.67
Non-prominent attribute	0.00	-0.08	0.00	-2.08
<i>Personally less relevant</i>				
Prominent attribute	2.00	0.42	0.83	2.25
Non-prominent attribute	-0.83	-0.33	0.42	-0.83

amount of attention to, and positive evaluation of, an option depends on whether it is finally preferred or not. Therefore, the attention and evaluation indices confined to attribute levels were calculated separately for options which were preferred (either chosen or receiving a higher preference judgement) and non-preferred, respectively (Table 5). In a first set of ANOVAs, the factors prominent/non-prominent and preferred/non-preferred option were crossed. Since these factors jointly interacted with some of the remaining factors, a second set of response mode (3)  $\times$  problem type (2)  $\times$  attribute (2)  $\times$  option (2) ANOVAs excluded preferred non-prominent and non-preferred prominent options. Due to more attention to the levels of the prominent attribute, in the ANOVA on the attention index the main effect of attribute reached significance [ $F(1,66) = 18.93, P < 0.001$ ]. A significant interaction between response mode and option was also obtained [ $F(1,66) = 9.62, P < 0.001$ ], reliably modified by problem type [ $F(1,66) = 3.69, P < 0.05$ ]. More attention was given to the non-preferred than to the preferred option for choices to accept and preference ratings, whereas the reverse was true for choices between options. For preference ratings, the difference was confined to personally relevant problems.

The ANOVA on the evaluation index showed that the levels of the prominent attribute were evaluated as reliably higher than the levels of the non-prominent attribute [ $F(1,66) = 80.13, P < 0.001$ ], and that reliably higher evaluations were given to preferred than to non-preferred options [ $F(1,66) = 5.71, P < 0.05$ ]. In the ANOVA including the factor prominent/

non-prominent option, response mode interacted reliably with preferred/non-preferred option [ $F(1,66) = 3.48, P < 0.05$ ]. When excluding this factor, the interaction was nearly significant [ $F(1,66) = 2.49, P < 0.10$ ]. The difference in evaluation between preferred and non-preferred options was larger for choices between options than for the other response modes. In Tukey *post-hoc* tests, only the former difference was significant. As revealed by significant interactions between response mode and attribute [ $F(1,66) = 10.79, P < 0.001$ ], and between response mode, attribute and option [ $F(1,66) = 20.01, P < 0.001$ ], for choices the difference between preferred and non-preferred options was reliably larger on the prominent attribute than for the other response modes. However, the difference was more, rather than less, negative on the non-prominent attribute.

### Discussion

Whether choices between options were construed as personally relevant or not did not seem to have an unequivocal effect. As predicted from the restructuring hypothesis, personally relevant problems affected the prominence effect for preference ratings. However, the effect was in the expected direction only for choices to accept. In addition, the think-aloud protocols did not indicate that personal relevance increased restructuring.

Evidence for restructuring preceding choices between options was obtained, in that the difference between the evaluations of preferred and non-preferred options were larger for choices between options than for preference ratings. However, choices to accept did not differ from preference ratings. A problem with the think-aloud data appears to be that sequential presentation led to positive evaluations of both levels of the prominent attribute and negative evaluations of both levels of the non-prominent attribute. More comparisons were thus made when both options were available simultaneously. To the extent that the think-aloud protocols can be interpreted as showing more restructuring for choices between options than for the other response modes, the results are inconsistent with the restructuring hypothesis, since there were no differences in prominence effect.

Against the compatibility hypothesis is the fact that, in the think-aloud protocols, more attention was not given to the prominent attribute. However, the prominent attribute was generally more highly evaluated than the non-prominent attribute. The compatibility hypothesis is also contradicted by the fact that an equally strong prominence effect was obtained for choices and preference ratings. This is in line with previous results (Montgomery et al., 1991; 1994).

In the present experiment, a simultaneous presentation mode did not increase the prominence effect. In contrast with previous studies (Mont-



gomery et al., 1990; 1994), presentation mode was varied for the qualitative (choices) rather than for the quantitative (preference ratings) response. Since the prominence effect for preference ratings, but not the prominence effect for choices, appears to be affected by presentation mode, the explanation may be that a simultaneous presentation mode increases comparisons between options (Birnbaum, 1992; Montgomery et al., 1994).

## EXPERIMENT 2

### Method

*Subjects.* Another 48 undergraduate students recruited from the same population served as subjects in return for payment. Twelve subjects were randomly assigned to each condition.

*Materials.* The materials consisted of the same eight choice problems as in Experiment 1, which were framed as being personally relevant.

*Procedure.* The subjects participated in groups of four, half of whom performed all tasks in a single session lasting about 20 min. The remaining subjects participated in two 10-min sessions separated by 1 week. In each sub-group, half of the subjects made choices of pairwise presented options, the other half performed preference judgements of one of the options in each pair.

In the choice conditions, the subjects who participated in one session received a booklet in which the choice problems were presented twice in two blocks according to the same individually randomised order. One value was missing for each choice problem—either the largest or smallest value for the prominent attribute, or the largest or smallest value for the non-prominent attribute. Across subjects and problems, which value was missing was counterbalanced. In the booklet, the attributes and options were ordered so that the missing value always appeared down on the right. On each trial, the subjects first filled in the missing value to make the options appear equally attractive, then they were requested to choose one of the options. The instructions told the subjects that “. . . despite that the options should be equally attractive, you may nevertheless, on a closer look, find one of them to be more attractive”.

Preference ratings were first made of one of the options in a pair, then of the other one when the choice problem was presented the second time. Which option was judged first was counterbalanced across subjects. A scale ranging from 1 (extremely bad) to 100 (extremely good) was used.



In the conditions with two sessions, the subjects performed the matching task in the first session. The choice problems were presented only once. In the second session, the missing values for each subject were replaced by those which he or she had filled in during the first session. The values obtained were printed in a new version of the booklet. Exactly as in the single sessions, the problems were presented twice. Choices were then made for each problem, whereas preference ratings were made for each option in each of the problems.

## Results and Discussion

From the matching results it was possible to calculate the ratio of the weights for the prominent and non-prominent attributes, respectively (see footnote 1). As shown in Table 6, these ratios were somewhat higher than in Experiment 1. This was most likely due to the fact that the missing values were not always the lowest value on the non-prominent attribute (cf. Tversky et al., 1988). However, a matching condition (2)  $\times$  response mode (2) ANOVA on the mean ratios across problems did not yield any significant differences ( $P > 0.05$ ).

The choices and preference ratings were scored as in Experiment 1. A score of 1 was assigned each time the prominent option was preferred in a pair, whereas a score of 0.5 was assigned if both options received the same preference rating. As Table 7 shows, consistent with previous results (Montgomery et al., 1990; 1994) a prominence effect was obtained in each condition. In a response mode (2)  $\times$  same/different session (2) ANOVA, the response scores were reliably different from 0.50 in all conditions ( $P < 0.001$ ). As expected from the restructuring hypothesis, the prominence effect was reduced when subjects performed the matching task in the same session. However, neither the main effect of session [ $F(1,44) = 2.32$ ,  $P < 0.20$ ], nor its interaction with response mode [ $F(1,44) < 1$ ], reached significance. In addition, the observed tendency was in particular observed for the preference ratings rather than for the choices as was expected. Thus, in these respects, the results were more consistent with the revised compatibility hypothesis.

TABLE 6  
Mean Ratios of Weights for Prominent and Non-prominent Attributes  
for Choice and Preference Rating (Experiment 2)

Choice		Preference Rating	
Same Session	Different Sessions	Same Session	Different Sessions
2.58	2.88	2.87	2.30

TABLE 7  
Mean Response Scores for Choice and Preference Rating (Experiment 2)

Choice		Preference Rating	
Same Session	Different Sessions	Same Session	Different Sessions
0.83	0.86	0.75	0.82

## GENERAL DISCUSSION

In both experiments in the present study, the prominence effect (Slovic et al., 1990; Tversky et al., 1988) was replicated. Although the options were matched to be equally attractive, the option with the highest value on the predominant or prominent attribute was more often chosen. This held true irrespective of whether the same or different subjects performed the matching task, whether the same subjects performed the matching task in the same or in a different session, or whether the missing values were the same or varied. As noted by Slovic et al. (1990), the prominence effect appears to be a reliable phenomenon.

Consistent with previous findings (Fischer & Hawkins, 1993; Montgomery et al., 1994), a prominence effect was also observed for preference ratings. In Experiment 1, a prominence effect was similarly found for choices to accept an option. Thus, the present results corroborate the generality of the prominence effect. At the same time, they question the explanations of the effect which have been offered.

Unless there is some other explanation of the prominence effect for preference ratings, observing such an effect is not in agreement with the compatibility hypothesis proposed by Slovic et al. (1990) and Tversky et al. (1988). This hypothesis only predicts a prominence effect for choices (Table 1). In addition, the think-aloud protocols did not indicate that subjects attended more to the prominent attribute as the hypothesis implies they would.

However, the alternative explanation of the prominence effect, the restructuring hypothesis (Montgomery, 1983; 1989; Montgomery et al., 1990), did not fare any better. The think-aloud protocols in Experiment 1 supported the assumption that subjects restructured the choice problems more frequently when they made choices between options than when they made preference ratings of sequentially presented options. In disagreement with the hypothesis, however, restructuring was not more frequent for choices to accept than for preference ratings. Furthermore, only in the case of choices between options was the observed restructuring



accompanied by a prominence effect. Since a prominence effect was obtained for the preference ratings and choices to accept, restructuring cannot be a sufficient explanation.

The protocols further revealed that construing the problems in Experiment 1 as personally relevant did not lead to more restructuring. One possibility is that restructuring cannot be affected in this way unless certain other conditions prevail. For instance, the differences in attractiveness of attribute levels may need to be small for restructuring to occur. Another possibility is that subjects did not interpret the personally relevant problems as more important, since they were very similar in content to the personally less relevant problems. Since content cannot easily be changed without altering the structure of the choice problems, a possibility would be to manipulate accountability. In contrast to Experiment 1, this was done by Simonson and Nye (1992, experiments 1, 2 and 5). The subjects in their high-accountability condition were told that they would later have to explain the basis of their choices to others. The subjects in the low-accountability condition received the same choice problems but were not asked to provide an explanation. The results suggested that this manipulation decreases the prominence effect, whereas the restructuring hypothesis predicts an increase. However, since the results were not clear-cut, they need to be replicated.

Montgomery et al. (1994) proposed a revised compatibility hypothesis to account for their results. This hypothesis makes similar predictions as the restructuring hypothesis (Table 1). An important difference is nevertheless that no effect is expected for personally relevant problems. Disregarding an effect in the opposite direction confined to choices between options, the results were consistent with the revised compatibility hypothesis. Yet, in disagreement with the hypothesis, a prominence effect was observed in Experiment 1 for choices to accept an option. Also in disagreement with the hypothesis, in Experiment 2 a prominence effect was found when subjects simultaneously performed the matching task. Still, the prominence effect tended to be weaker in this condition compared with a condition when the matching task was performed in a different session.

The main contribution of the present study is to provide further evidence for the generality of the prominence effect. In particular, it has been shown that preference ratings are equally susceptible to the effect as choices are. However, it appears that none of the explanations offered is completely viable.



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